HICO-ULTRASONAT 810

SERVICE MANUAL

Item No. 390001 Rev. 0-12/04

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1. General Notes and Process

The HICO-ULTRASONAT 810 is an ultrasonic nebulizer. The device is used in medical-technical applications to nebulize water to which inhalation medications have been added. This is a low-cost device.

Please consult the function and switching description before operating the device. The complete function incl. tests and calibration are explained in these sections.

1.1 Initial Startup / Calibration

A few items have to be considered during initial startup:

1.) The ultrasonic nebulizer may only be operated with programmed µcontroller since the controller also assumes the task of limiting the output of the output transistor. The switching unit can be damaged without controller.

2.) The output transistor may never be operated without heat sink.

3.) The switching unit always has to be operated with a sufficiently filled water container that includes a mounted original transducer for these devices.

4.) This device is not equipped with a main or mains switch! As soon as the supply voltage is connected to the transformer, the µcontroller starts as well and then may not be plugged in or unplugged. The µcontroller also runs if the device was switched off using the keyboard! (Standby mode)

5.) The supply voltage for the initial startup has to be 230V +/- 10% and – 230V +/- 3% for the calibration.

Initial startup of the device consists of two steps. The first step is launched while the device is switched off. Press the "ventilation"-key and at the same time additionally the "timer"-key and the "start"-key .

Activation is only possible according to the key sequence described.

The first step consists of switching the ventilator on, using low capacity. The start-LED is lit. The (yellow) reset-LED flashes every 10 seconds. The key-lock-LED indicates the status of the MAX-signal-comparator.

The error-lock-LED indicates the status of the ERROR-comparator. Two of the "timer"-LEDs, "nebulizing"-LEDs, and "ventilation"-LEDs are shining. The intensity increases slowly to the max. value. The max. value is then adjusted as needed.
If the start key is pressed during the first step the device will switch off again without saving the settings.

However, if the "nebulizing"-key is pressed, the second step of the initial startup function is activated.

The second step consists of switching the ventilator to full power. The start-LED continues to be lit. The reset-LED flashes every second. The status-LEDs indicate the complimentary status of the first step. The key lock and the error-LED continue to depict the comparator statuses. The intensity continues to be adjusted to the max. value.

The device switches off again if the start key ⏻ is pressed during the second step. Settings are saved in this case. The max. value for the output limiter is simultaneously calculated and saved to EEPROM.

Initial startup requires the use of a filled and flawless water container. Do not activate the initial startup if such a container is unavailable! Always use the correct transducer and a supply voltage of 230V (+/-10%) because the output limiter is not activated and is calculated and applied with this initial startup

.

The output limiter setting remains permanently stored in EEPROM. However, it has to be carried out again if the EEPROM, the µcontroller or the software or transistors connected with the oscillator are replaced!

1.2 Operating Hours Query

The device is equipped with an operating hour counter. Because the device does not feature a numeric display, the status of the operating hour counter is depicted binary with the help of the timer, nebulizing, and ventilation LEDs. The smallest displayable time is approx. 10 hours. This means the operating hour counter can depict max. 40960 hours in a binary encoded mode if equipped with 12 LEDs. The 120-minute timer LED is here the lowest order bit and the 25% flow LED is the highest order bit. To display these values, switch the device off and press and keep depressed the "key lock" key (depicted below product designation as an indentation in the keyboard foil) while pressing the start key ⏻ at the same time.

The status is indicated with the flashing error-LED ϟ. The device is switched off again with the start key.

2. Fault Messages and Search

The following table is an aid to recognize and remedy faults and makes no claim of completeness.

The device may only be opened by qualified personnel.

The power cord has to be removed before opening device!

FAULT (message)	CAUSE	REMEDY
Operating indictor, start LED does not flash and device does not function	Interruption of mains supply	Check plug connections of mains power supply and mains fuses
Operating indicator, nebulizing, and ventilation LEDs are lit but nebulizing cloud is not generated	1. Transducer is defective 2. Fuse is defective	1. Replace transducer 2. Replace fuse (by medical technician or customer service)
Error-LED constantly lit	1. Water container is empty 2. Sound absorber is plugged	1. Refill water container 2. Missing or incorrectly installed water container with transducer
Error LED flashes	The device is equipped with an output limiter: 1. An incorrect transducer is inserted. 2. The supply voltage is too low (less than 230v - 10%). 3. The operating voltage of the transducer has not been reached.	 1. Replace transducer and recalibrate device. 2. Check supply voltage. 3. Check or replace fuse (by medical technician or customer service)

All of these cases result in a fault status that has to be acknowledged by using the start key ⏻ to switch the device off.

3. Technical Data

Supply voltage:	230 VAC 50/60 Hz / 115 VAC 50/60 Hz
Current consumption:	0.4 A / 0.8 A
Power consumption:	approx. 85 W
Nebulizing output:	max. 4.5 ml/min
HF output:	approx. 32 W
Oscillator frequency:	1.7 MHz
Particle size:	0.5 -6 µm
Nebulizing temperature:	max. 43 °C
Ambient temperature:	10 -30 °C
Storage temperature:	10 - 40 °C
Dimensions : (W x H x D)	300 x 250 x 320 mm
Chamber volume:	max. 625 ml
Overall eight: (including base)	approx. 1200 mm
Weight (unit):	4 kg
Weight, compl.:	18 kg
Classification:	Protection class I, Type B

4. Repairs / Maintenance

The service manual serves as a guideline for checking and testing customer devices (repairs/maintenance). The inspection and test status is identified with a green dot attached to the unit if the inspection was successful. This inspection is a parts inspection.

4.1 Visual Check

- Check screws for tight and proper fit. (Device plug, case)
- Check power cable, power plug.
- Check for soiling, damage.
- Check grounding plate and air filter for proper fit.
- Check device labels (heater connection, etc.) and type plate.
- Check connection of tubes and angle adapter with bacteria filter.

4.2 Electrical Test (EN 60601-1)

The measurement is carried out based on the instructions of the test equipment manufacturer. The front screw at the ventilation guard grid from the bottom is the test point - this is where the greatest resistance can be expected.
The tests are carried out with the mains connection line associated with the device!

- **Measuring the protective conductor resistance R_{SL}**

The value determined for the protective conductor resistance (incl. test, mains power connection line) should not exceed 0.15 Ω. The limit value of the IEC regulation is 0.2 Ω.

- **Measuring the grounding current I_{SL}**

The value determined for the grounding current should not exceed 100 µA. The limit value of the IEC regulation is 500 µA.

4.3 Function Check

This test is performed as described in the test and inspection instructions.

- Connect water container
- Fill water container (The water level should be about 2 to 3 cm)
- Charge heater connection. (Test lamp)
- Supply power from the mains supply to the device.
  - Check whether the green start-LED is flashing
- Switch the device on using the start key. ⏻
  - Check whether the green start-LED is lit
  - Check whether the test lamp is lit
  - Check whether the device is in the continuous operating mode (the timer-LEDs are not lit)
  - Check whether the "nebulizing"-key is locked when first switching the device on (initial 10 to 15 seconds).
  - Check after 15 seconds, whether all three setting keys are available again (pressing the key should change the statuses of the LEDs).
  - Switch the device off using the start key. ⏻
- Check operating hour counter: With device switched off, press and keep the "key lock" key depressed while simultaneously pressing the start key. ⏻
  - Check whether the status is correctly indicated by the flashing error-LED
  - Check whether the status of the operating hour counter is depicted in a binary mode with the help of the ventilation, nebulizing, and timer keys.
- Switch the device on using the timer key .
  - Check whether a few timer-LEDs are lit.
  - Switch the device off using the timer key (neutral position)
- Launch step 1 of the initial startup function: Press the "ventilation" key and keep depressed while also pressing the timer key and the start key ⏻ .
  Device has to set nebulizing action to 100%.
  - Check function of the LEDs: Every second LED is lit.
  - Reset-LED (yellow) flashes every second.
  - Check function of the MAX signal comparator. (Key-lock-LED flashes)

- Check function of the ERROR comparator (error-LED ϟ flashes if the water container has been tilted far enough for the transducer to dry out temporarily).
- Ventilator runs at low rpm (check by listen to device).

- Launch step 2 of the initial startup function: Press "nebulizing"-key .
  The ventilator is switched to full power.
  - Check function of the LEDs: Check whether the status-LED indicates the complementary status for step 2.
  - Reset-LED (yellow) flashes every second.
  - Check function of the MAX-signal comparator. (Key lock-LED flashes)
  - Check function of the ERROR comparator. (Error-LED ϟ flashes if the water container has been tilted far enough for the transducer to dry out temporarily).

- Switch the device off using the start key – automatic alignment is saved.

- Switch device on again. (Normal operation) Remove water container.
  - Check whether the error-LED ϟ is lit
  - Acknowledge error with the start key and thereby switch device off.

- Switch device on again. (Normal operation) Tilt water container so that transducer runs dry.
  - Check whether the error-LED ϟ is lit
  - Acknowledge error with the start key and thereby switch device off.

- Switch device on.
  - Set timer to 15 minutes using the timer key and check whether the nebulizing action quits after the set time has expired.

- Check key lock function:
  - Press the "key lock" key (located under the product symbol and shown there as an indentation in the keyboard film) for longer than 5 seconds.
  - Check whether the key lock-LED is lit.

  - Check whether the "nebulizing" and "ventilation" keys are locked.
  - Press "key lock"-key once more for longer than 5 seconds and check whether the key-lock-LED has gone out and the "ventilation" and "nebulizing" keys are available again.

Parts List

REF	DESCRIPTION	PIECES
392101	Bottom plate, aluminum 2 mm	1
392102	Ventilator, Papst 612 NGL-12 V	1
392103	Socket board 926475 3P	2
392104	Socket contact 141708-1	2
392105	Protective grating LZ 28	1
804774	Oval head screw M4 x 12 m.cross-tip	4
804512	Toothed washer, J 4.3 pcs	8
804502	Nut, M4 MsNi, DIN 934	4
804221	Rubber pad, touch-sensitive adhesive SJ 5514	5
804569	Countersunk screw WN 1413, KA35x16	8
392201	Case shell 810 cpl.	1
382217	Pin sockets (short)	1
382218	Pin sockets (long)	1
382204	Contact pins E, nickel-plated	1
382206	Contact pins D, nickel-plated	1
382207	Contact spring, copper wire	2
391204	Film keyboard f. USV 810	1
382909	Screw, cross-tipped. M8x30,D=30	1
382309	Coarse air filter	1
392205	Mains supply input filter FN 92236 -1-07	1
804706	Oval head screw, sheet-metal screw, cross-tipped	2
392206	Ventilator fan, 412 H	1
804183	Cable tie	1
312106	Insulating material, VITO tape, black	0.15
392207	Cooling unit, special, aluminum	1
392600	I/O board 810	1
393500	Heater board 810	1
382328	Sicker "heater connection" type	1
392800	Control board 810	1
804763	Screw, oval head, AM 3x6mm,4,8 pcs	13
804250	PE symbol 112 012 mm	1
828509	Type plate, form No. 6011	1
392700.	Nebulizing chamber, equipped	1
392701	Nebulizing chamber, raw	1
392702	Contact plate f. 810	1
382769	Transducer with printed board	1
382715	Transducer (quartz)	1
382768	Printed board disk for quartz	1
392705	Angle adapter No. 1992	1
383110	Bacteria filter	1
383109	Aerosol hose (100 cm)	1
383502	Heatable aerosol hose, cmpl	1
383505	Heater hose	1
383508	Cable plug, 3-pol	1
830002	Adhesive, Elastosil E 43	0.089
390601	Level controller f. USV 810	1
383102	Screw cap	1
383103	Silicone sealing, D36xD20x1.5	1
383106	Spring clip, PBT ,d10, blue	1
383107	Needles f. level controller	2
393114	Level pipe, short, 810-40 m	1
804217	Silicone hose 3x2	0.32
822531	Flat bags, PE 180x260x0.55 mm	1

382716	Penicillin plug VERSILIC	1
382320	Mains cable HO5VV-F3G1 type 303A	1
382801	Bottle holder	1
382802	Star grips DIN 6336A M5x20	1
392122	Operating instructions 810	1

Parts List
Control and Operating Board – Ultrasonic Nebulizer
Hirtz HICO Ultrasonic Device Rev. 1.2
Status: 23 June 2003, 12:30:43

Item	QTY	Component name	Description	Value/Type	Comment
1	3	C4, C17, C6	MKT film capacitor 100nF/250V 10% RM 7.5 EPCOS B32560-J3104...	100nF/250V MKT	
2	8	C22, CIO, C23, C24, C11, C3, C19, C20	M ceramic capacitor 100nF/50V RM2.54mm	100nF	
3	1	C8	MKT film capacitor 10nF/400V 20% RM 7,5mm EPCOS B32560-J6103-...	10nF1400V MKT	
4	6	C21, C15, C12, C2, C9, CI	ELKO 10uF/35V erect D-4.8mm RM=2mm	10uF/35V	
5	1	C200	MKT foil capacitor 150nF250V 10% RM 7.5mm EPCOS B32560-J3154-...	150nF/250V MKT	
6	1	C7	MKT foil capacitor 1,5nF/400V 10% RM 7.5mm EPCOS 832580-J6152-...	1.5nF/400V MKT	
7	2	C25, C26 '	Ceramic disk capacitor 220pF250V Safety Class Y1 Vishay Type WKP221	220pF/250V-Y1	
8	2	C13, C14	Ceramic capacitor 22pF/50V RM=2.54mm	22pF	
9	2	C201, C202	Ceramic disk capacitor 2.2nF250V RM 5mm D=9mm Vishay WYO 222	2.2nF250V	
10	1	C16	ELKO 470uF/100, erect, RM 7.5mm, 0=16.5mm	470uF/100V	
11	1	C18	ELKO 470uF/25V radial design RM5mm D=10mm	470uFI25V	
12	1	C5	MKT film capacitor 47nF250V 10% RM 7.5mm EPCOS B32560-J3473-...	47nF250V MKT	

13	2	X7A, X3A	Additional mechanical component (see value for details)	Cover plate, gray for WAGO256	
14	1	V2A	Additional mechanical component (see value for details)	Insulating disk TO 218 (Fischer GS218)	
15	1	U4B	Additional mechanical component (see value for details)	Nut M3 StZn	
16	4	TIE, TIF, T1 G, TIH	Additional mechanical component (see value for details)	Nut M4 StZn	
17	1	F5A	Additional mechanical component (see value for details)	Fuse 5 x 20mm M 0.5A	
18	1	F3A	Additional mechanical component (see value for details)	Fuse 5 x 20mm M 1.25A	
19	2	FIA, FZ#	Additional mechanical component (see value for details)	Fuse 5 x 20mm T 1A	
20	1	F4A	Additional mechanical component (see value for details)	Fuse 5 x30mm T 4A	
21	5	S104A, 8100A, SIOIA, S102A, 8103A	Additional mechanical component (see value for details)	Key cap Rafi Raoon to 6.46067.042	
22	1	U4C	Additional mechanical component (see value for details)	Toothed washer M3 StZi,	
23	1	U4A	Additional mechanical component (see value for details)	Cylinder head stud M3c8 StZn	
24	4	T1B, TIC; T1D, TIA	Additional mechanical component (see value for details)	Cylinder head stud M4x8 StZn	
25	2	F1, F2	Fuse holder FPG4 10A 250V grid 5.08mm 7.62mm	T 1A	
26	1	F5	Fuse holder with cap for fuses 5x20mm Type ESKA 508.000	M 0.5A	
27	1	F3 F3	Fuse holder with cap for fuses 5x20mm Type ESKA 508.000	M 1.25A	
28	1	F4	Fuse holder with cap for fuses 5x20mm Type ESKA 506.000	T 4A	
29	1	K1	Relay 2xUM 250V/8A 12V coil finder 41.52.9.12.0000	Finder 41.52 - 12V	
30	1	L1	Coil Fasttun Type 3MCC 100uH 370mA	100uH	
31	1	L200	Current compensated throttle 2 x 2.7mH/4A horizontal EPCOS 882723-A2402-N1	2 x 2.7mR / 4A	
32	1	L4	Current compensated throttle 2 x 3mH/1A erect EPCOS 882720-K2102-N40	2 x 3mH / 1A	
33	1	L3	Coil 27uH 1A +/-1O% different grid dimensions possible	27uH	

34	2	L201, L202	Ferrite bead Wuerth Elektronik 742750 9008 at 100MHz	Ferrite bead	
35	1	L2	PCB coil 4 windings ca. 100...150nH (not to be equipped)	4 windg. PCB coil	
36	1	Q2	Quartz 12.0000MHz HC49/U case	12.0000MHz	
37	1	R500	Metal film resistance 0R (wired)	0R	
38	1	R3	Metal film resistance 100K 1% 0.4W TK50 0207 (wired)	100K	
39	1	R4	Metal film resistance 1008 1% 0.4W TK50 0207 (wired)	1008	
40	1	R1	Metal film resistance 0R (wired)	10KO	
41	1	R16	Metal film resistance 0R (wired)	150K	
42	1	R9	Metal film resistance 0R (wired)	15K	
43	1	R11	Metal film resistance 0R (wired)	18K	
44	1	R15	Metal film resistance 0R (wired)	1 R0/2W/2%	
45	5	R12, R8, R7, R14, R6	Metal film resistance 0R (wired)	3K9	
46	1	R10	Metal film resistance 0R (wired)	470R	
47	1	R5	Metal film resistance 0R (wired)	47K	
48	1	R2	Resistance network 10K x 8 SIL-9 (marked as individual resistances)	10K	
49	1	R13	Resistance network 470R x 5 SIL-6 (marked as individual resistances)	470R	
50	5	S100, S104, S103, 5102, S101	Sensor for front films RAFI Racon 8H with inside pins 1.14100.012	RAFT-Recon 8H	Timer, Power On/Off, Keylock/Reset, Flow, Intensity
51	1	S1	Voltage selector switch Schurter Type SWA 115V/230V printer connection	Schurter SWA	
52	1	T1	Trafo Marschner EI84/29.51St2 special design (Hirtz HICO Ultrasonat)	E184129.5/St2	
53	1	U4	Voltage controller 7805 5V IA T0220 case by different manufacturers	7805	
54	1	U3	EEPROM 16kbyte 12C-Bus AT24C16 DIP-8	AT24C16	
55	1	U2	uControlier Atmel AT89C4051 8051 compatible (4k Flash) DIP20	AT89C4051+ base	
56	1	U1	2x comparator LM3931m DIP-8 case	LM393	
57	8	V140, V144, V141, V142, V143, V4, V9, V7	SI diode 1N4148 75V 100mA	1N4148	
58	1	V2	Power transistor Toshiba 28C5200 NPN 230V/15A 30MHzB=55...160	2SC5200	
59	2	V11, V12	Rectifier 880C1500 80V/1.5A Diotec BxxR series	B8OC1500	

60	2	V14, V13	Schottky diode BAT85 30V/200mA case D034	BAT85	
61	5	V1, V5, V6, VI0, V8	NPN transistor BC547C TO-92 B-420...800	BC547C	
62	1	V133	LED 3mm red Low Current HLMP-1700	HLMP-1700 (red)	error
63	1	V132	LED 3mm yellow Low Current HLMP-1710	HLMP-1719 (yellow)	reset
64	14	V100, V101, V102, V103, V110, V111, V112, V113, V120, V121, V122, V123, V130, V131	LED 3mm green Low Current HLMP-1790	HLMP-1790 (green)	Time 120Mln., Time 60Mln., Time 30Mln., Time 15Min., V103, V110, V111, Int. 100%, Int 75%, Int. 50%, Int 25%, Flow 100%, V112, V113, V120, Flow 75%, Flow 50%, Flow 25%, Power, KEYLOCK
65	1	V3	Quick rectifier diode UF4007 1000V/1A trr=15ns DO34	UF4007	quick diode, no 1N40071
66	1	X203	3-pol DIN socket with bayonet catch, erect, (with soldering bell) Amphenol T 3277 100	3-pol DIN socket	
67	1	X100	Flex strip line 12-pol 38, 1mm Tyco/AMP Type FSN 21.5 A-12	Flex strip	
68	1	X1	Flex strip line 12-pol 38, 1mm Tyco/AMP Type FSN 21.5 A-12	Flex strip socket 12-pol	
69	1	X2	Post strip without trough, 1-row 3 pins RM2.54mm	Post strip 1x3	ventilator
70	2	X201, X200	Soldering point hole=1.2mm to solder a line (1mm^2)	Heating	HO5V-K tmm^2, H05V-K 1mm_^2
71	1	X202	Soldering point hole=1.2mm to solder a line (1mm^2)	PE	H05V-K 0.75mm^2
72	1	X4	Cage terminal 2.5mm^2 16A RM5.06 blue, Wago Type 258-744	Wago256 blue	
73	3	X3, X8, X7	Cage terminal 2.5mm^2 16A RM5.06 gray, Wago Type 256-401	Wago256 gray	
74	2	X5, X8	Cage terminal 2.5mm^2 16A RM5.06, green, Wago Type 256-747	Wago256 green	
75	1	YI	Transducer connection for HICO ultrasonic device water container	Transducer	

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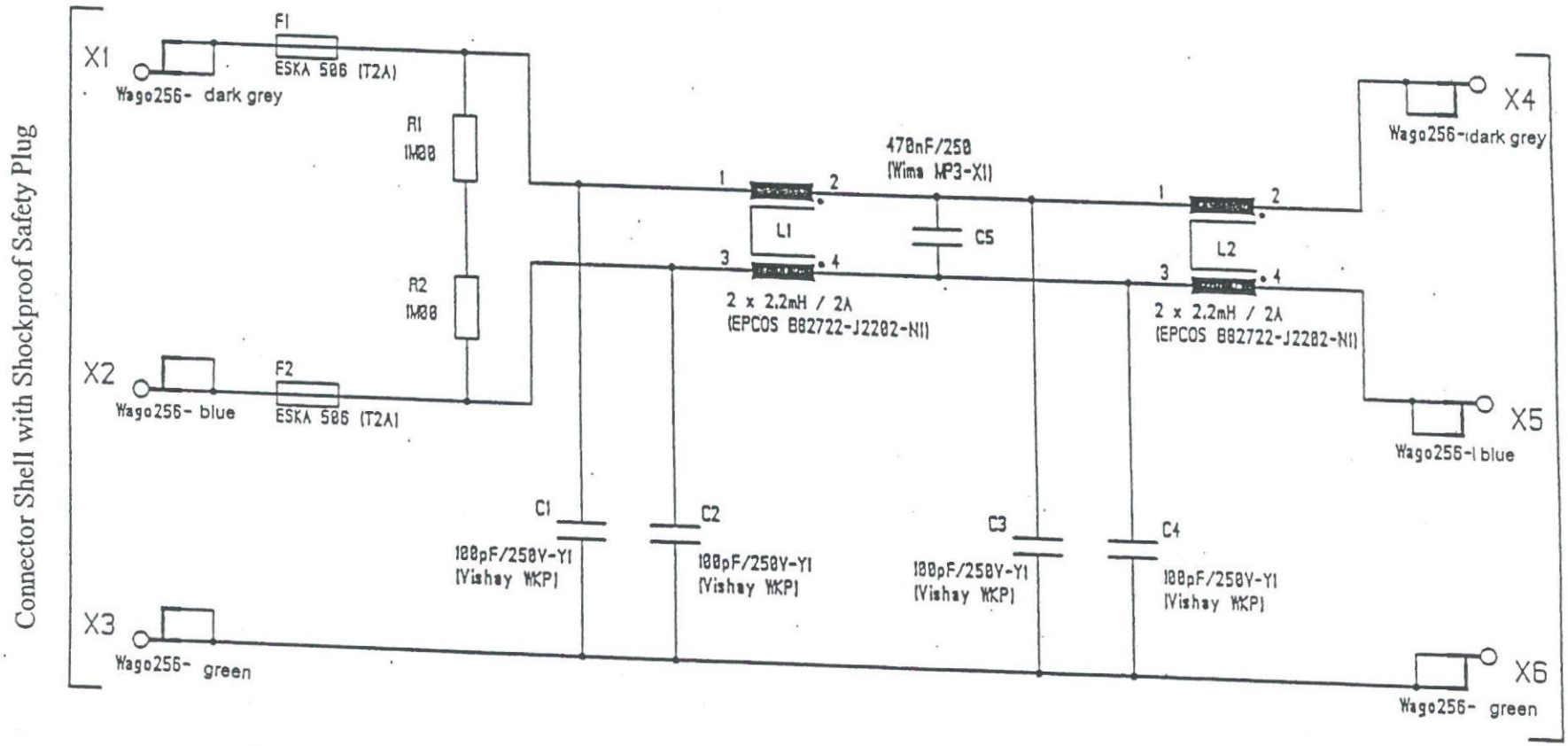


DAVIDSMEYER & PAUL GmbH
Karl-Heinz Beckurts Str. 13
52428 Julich

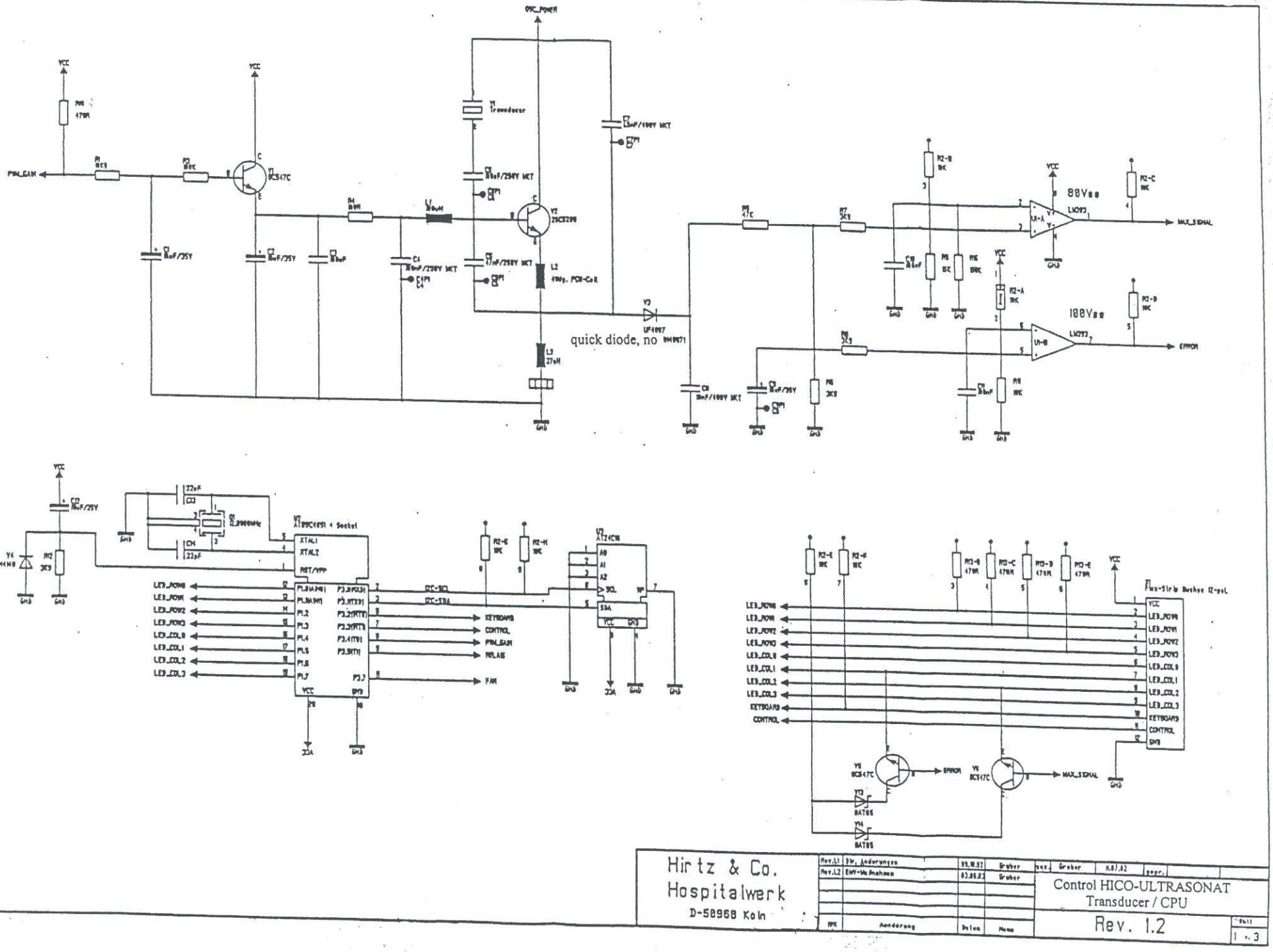
IDX	Aenderung	Datum	Name

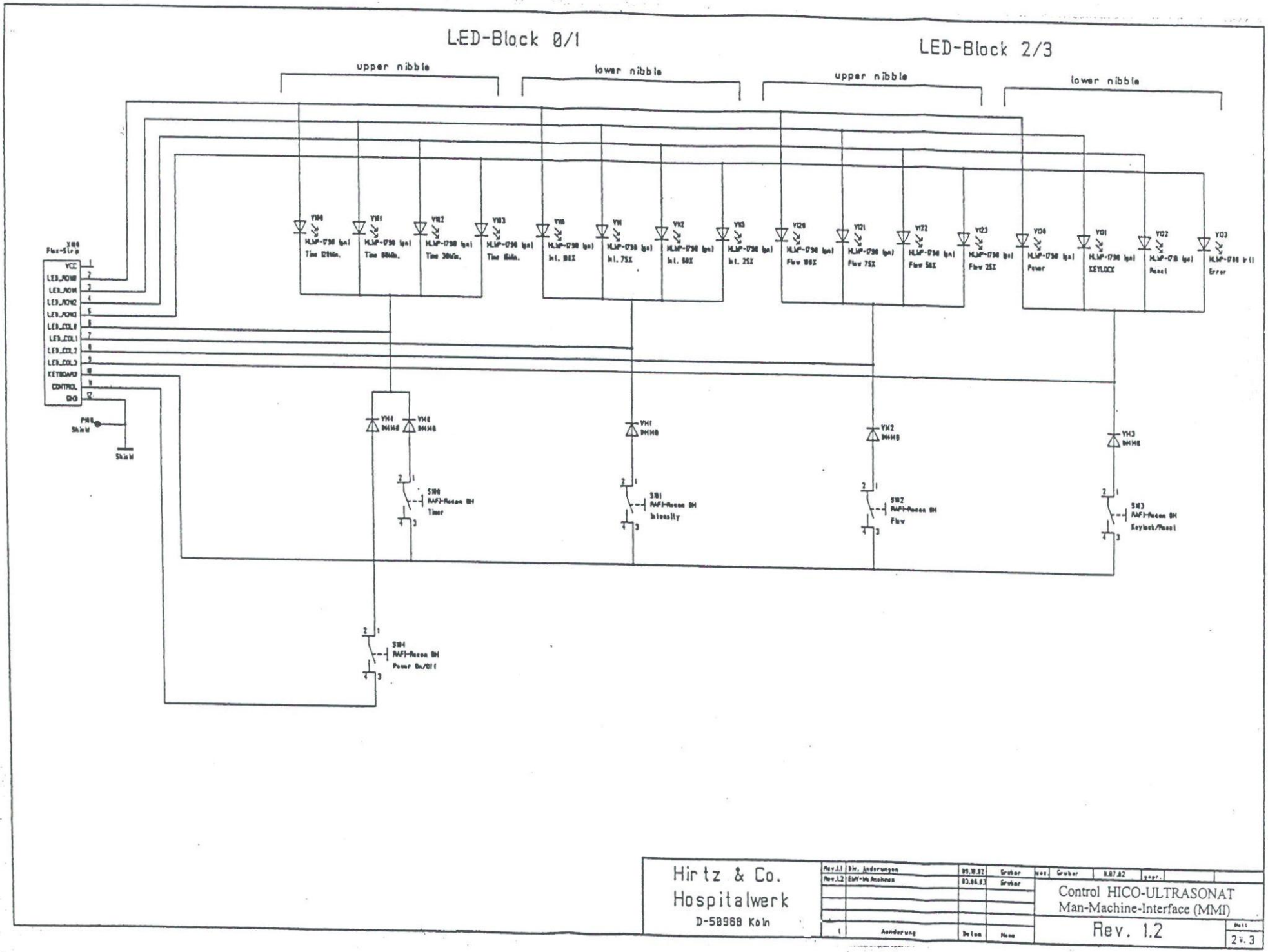
gez. 11.07.03 E. Gruber gepr.

Additional Filter Line
for HICO-ULTRASONAT

Rev. 1.0

Blatt 1 v. 1


quick diode, no
Hirtz & Co.
Hospitalwerk
D-50968 Koln
Control HICO-ULTRASONAT
Transducer / CPU
Rev. 1.2


LED-Block 0/1
LED-Block 2/3
upper nibble
lower nibble
upper nibble
lower nibble
XH6
Flex-Strip
VCC
LED_ROW0
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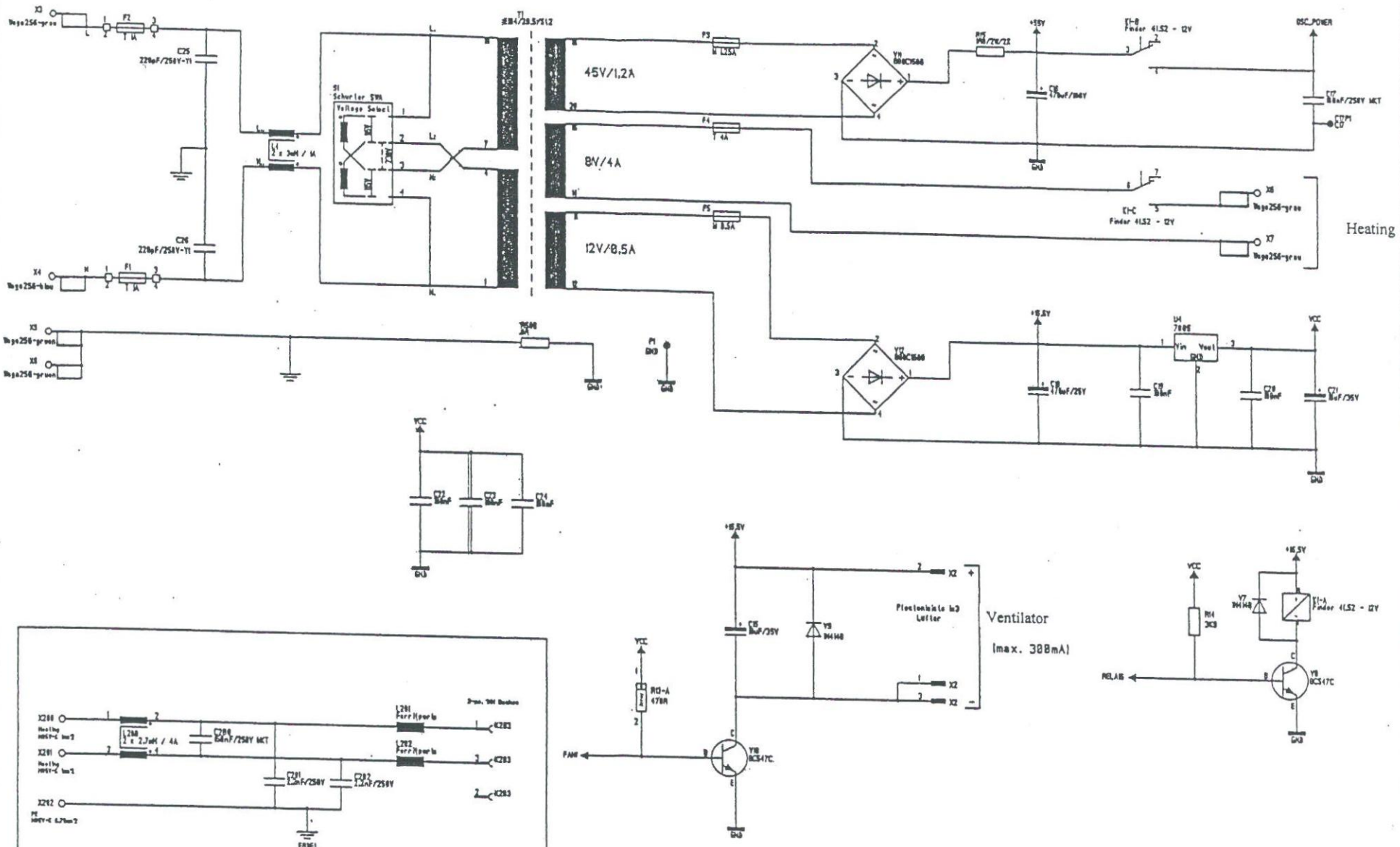
LED_ROW2
LED_ROW3
LED_COL0
LED_COL1
LED_COL2
LED_COL3
KEYBOARD
CONTROL
GND
PWR
Shield
Shield
YH4
BHH8
YH5
BHH8
YH1
BHH8
YH2
BHH8
YH3
BHH8
SW0
RAFI-Rocon 8H
Timer
SW1
RAFI-Rocon 8H
Intensity
SW2
RAFI-Rocon 8H
Flow
SW3
RAFI-Rocon 8H
Keylock/Reset
SW4
RAFI-Rocon 8H
Power On/Off
Hirtz & Co.
Hospitalwerk
D-50968 Koln
Control HICO-ULTRASONAT
Man-Machine-Interface (MMI)
Rev. 1.2
24.3



Hirtz & Co. Hospitalwerk D-50968 Koln	Rev.11	Dkr. Änderungen	95.10.92	Gruber	gez. Gruber	6.87.92	gepr.
	Rev.12	EMV-Maßnahmen	03.06.93	Gruber			
	Ind.	Aenderung	Datum	Name			

Control HICO-ULTRASONAT
Power Supply
Rev. 1.2

Blatt 3 v. 3

The manufacturer recommends a regularly conducted safety inspection (EN 60601-1). This safety inspection is certified with this document.

The inspection is carried out based on Service Manual SM 390001 + Operating Manual			
Product	**HICO-ULTRASONAT 810**		
Serial No.			
1. Visual Inspection			
Result of visual inspection (soiling, damage, etc.)		OK	not OK, because...
	Screw connections	☐	☐ .....
	Course air filter	☐	☐ .....
	Device labels	☐	☐ .....
	Case	☐	☐ .....
		☐	☐ .....
		☐	☐ .....
Other deviations/nonconformities:	.....		
	.....		
2. Electrical Inspection			
PE	☐ in order	Ω	(< 0,15 Ω)
Ground	☐ in order	µA	(≤ 100 µA)
3. Function Test			
Function test	☐ in order	☐ not in order because:	
	.....		

Inspection Result	
The device at hand the safety inspection (EN 60601-1)	☐ **passes.** Plate with next inspection date will be issued. ☐ ☐ **fails.**
The next safety inspection is due:	Date:
Inspector:	Date: Signature:

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